BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : B65H 26/06 — A1

(11) International Publication Number: **WO 00/63100**

(43) International Publication Date: 26 October 2000 (26.10.00)

(21) International Application Number: PCT/US00/10761

(22) International Filing Date: 20 April 2000 (20.04.00)

(30) Priority Data:

60/130,137	20 April 1999 (20.04.99)	US
60/159,006	11 October 1999 (11.10.99)	US

(81) Designated States: AU, BR, CA, MX, NZ, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(71) Applicant *(for all designated States except US)*: THE COLMAN GROUP, INC. [US/US]; 555 Koopman Lane, Elkhorn, WI 53121 (US).

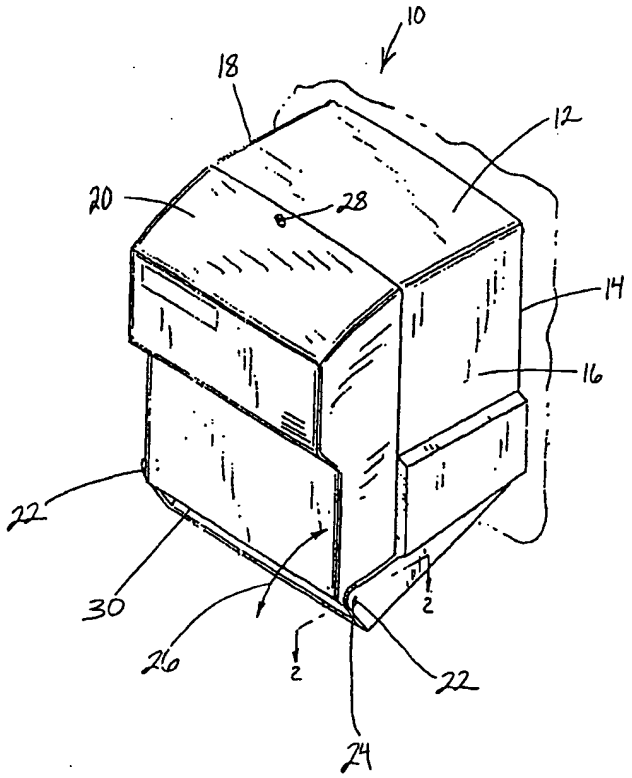
(71)(72) Applicants and Inventors: OMDOLL, Paul, A. [–/US]; S72 W26135 Vista del Tierra, Waukesha, WI 53189 (US). HOYT, Steven, D. [US/US]; 732 Main Street, Lake Geneva, WI 53147 (US).

(74) Agents: BROOKMAN, Adam, L. et al.; Godfrey & Kahn, S.C., 780 North Water Street, Milwaukee, WI 53202 (US).

(54) Title: ELECTRONICALLY CONTROLLED ROLL TOWEL DISPENSER WITH DATA COMMUNICATION SYSTEM

(57) Abstract

An electronically controlled roll tower dispenser (10) with a data communication system. The dispenser automatically dispenses a predetermined length of paper toweling from the supply roll (70) after a length of toweling has been detached by a user pulling and tearing the protruding toweling against a stationary cutting blade. The dispenser is battery powered by an electric motor, an electromechanical dispensing mechanism, and an embedded microcontroller for controlling and monitoring operation of the dispenser. In addition to primary control functions, the microcontroller monitors parameters such as battery condition, towel usage, system status, system errors, and unsafe operating conditions. Pushbutton switches (132, 134, 136, 138) are also provided for programming towel length and the dispense delay. The dispenser further includes an optical transmitter for transmitting visual and infrared data to a receiving device. Useful information about the status of the dispenser can be visibly discerned by an operator through the use of primitive low-speed flash patterns, while high-speed infrared digital data can be simultaneously embedded in or multiplexed with the visible data.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

ELECTRONICALLY CONTROLLED ROLL TOWEL DISPENSER WITH DATA COMMUNICATION SYSTEM

Cross-Reference to Related Applications

This application claims the benefit of U.S. Provisional Application Serial No. 60/130,137, filed April 20, 1999 and U.S. Provisional Application Serial No. 60/159,006, filed October 11, 1999.

Background of the Invention

The present invention relates generally to paper towel dispensers, and more particularly to an automatic electronically controlled roll towel dispenser with a data communication system for collecting data from the dispenser and transmitting the data to a receiving device for analysis.

Dispensers for dispensing paper towels are well known in the art. A paper towel dispenser typically requires a user actuate a mechanism for the dispenser to dispense paper toweling. Folded paper towels are pre-cut and folded into various configurations to be individually dispensed. Roll paper towels are continuous rolls of paper which are wound around a central core and dispensed by advancing a length of paper toweling from the dispenser and tearing off the length of toweling along a stationary cutting bar in the dispenser.

Folded towels are paper towels which are pre-cut and folded into various configurations. The use of folded paper towel dispensers allows a user to dispense towels by pulling on the exposed end of each new individual towel. These dispensers are also very easy to refill with folded towels. However, a number of the folded towels will often fall out when an exposed towel is pulled. This can result in a significant waste of paper towels. Accordingly, folded towel dispensers are not as economical as other types of alternative dispensers.

Roll towels are less expensive to manufacture and produce less waste than folded towels. A roll towel dispenser typically includes a housing, a supply of paper in the housing, and a

mechanism for unrolling a length of paper for use. Roll towel dispensers may include a lever, crank, or other mechanism for dispensing a length of towel from the dispenser chassis and a serrated blade for cutting the length of towel from the remaining roll. However, manual contact with a dispensing lever or the like raises health concerns for the user. To alleviate these health concerns, dispensers have been developed, such as disclosed in U.S. Patent No. 4,712,461 to Rasmussen, that eliminate contact with any part of the dispenser, and instead rely upon the user directly pulling the paper towel from the dispenser. In these type dispensers, the paper toweling must have sufficient strength to effect rotation of the feed roller and actuation with the cutting blade without premature tearing. Paper possessing the requisite strength to operate these dispensers is limited in the amount of softness and absorbency it can provide.

Another disadvantage of manual roll towel dispensers is that the user generally controls the length of paper dispensed prior to tearing it off the dispenser. A user can therefore wastefully dispense an excessive length of toweling. This adds to the waste and abuse associated with known paper towel dispensers.

Electrically powered roll towel dispensers are also known in the prior art. Such an example is disclosed in U.S. Patent No. 5,452,832 to Niada. In the Niada patent, a light sensitive device is used to detect the presence of a user's hand in front of the dispenser. After detecting the user's hand, the dispenser advances paper toweling for a predetermined length of time. The dispensed length of paper towel is then separated from the supply roll by pulling the paper toweling against a serrated cutting bar on the dispenser.

U.S. Patent No. 4,738,176 to Cassia discloses an electrically powered dispenser which includes a reciprocating cutter to produce an individual towel from the continuous web of paper. While this arrangement enables the use of softer and more absorbent paper, the dispenser

requires a substantial amount of energy to drive both the feed mechanism and the reciprocating cutter. Accordingly, the batteries for this dispenser must be replaced frequently. Moreover, the dispenser design is much more complex and costly than other systems.

Also, in some electrically powered dispensers, such as the dispenser disclosed in U.S. Patent No. 4,796,825 to Hawkins, the paper will continuously dispense while a user's hand or other object is placed in front of the sensor. Thus, the dispenser is subject to easy abuse and waste of paper. In an effort to avoid abuses, some dispensers, such as U.S. Patent No. 4,666,099 to Hoffman, have incorporated a waiting period where the dispenser will not operate for a brief time after each use. However, the need to wait can be frustrating to some users.

None of the known prior art dispensers incorporate a microcontroller or an electromechanical triggering mechanism for controlling operation of the roll towel dispenser. In addition, none of the prior art shows or discloses the use of an optical data link for transmitting status and usage data to a receiving device for analysis.

Optical data links are also well known in the art for use in transmitting data between electrical devices. For example, U.S. Patent No. 5,691,699 to Vane et al. discloses a security detector having an optical data transmitter. Communication with visible light is typically limited to use with fiber-optic data links, while open-air optical data links typically operate in the infrared (IR) range. Well known are the familiar IR-remote control devices used to control home video and audio electronics. Other familiar methods of optical data communication include the Infrared Data Association (IrDA) standard used with personal computers, lap tops, computer peripherals, and personal organizers to provide wireless data transfer between devices.

Therefore, there is a need for an improved electronically controlled roll towel dispenser having an embedded microcontroller for controlling and monitoring the dispenser, and having a

transmitter for transmitting data to a receiving device that is of a simpler design and is less expensive than prior art systems.

Summary of the Invention

It is therefore an object of the present invention to provide a paper towel dispenser for automatically dispensing a predetermined length of paper towel in response to the tearing off of a previously dispensed length of towel.

It is a further object of the invention to provide a dispensing apparatus for paper towels that is touchless and automatic.

Another object of the invention is to provide an apparatus which automatically supplies a predetermined length of paper toweling from the roll.

A further object of the invention is to provide an automatic roll towel dispenser which does not require physical contact by the user.

Still another object of the invention is to provide a dispenser wherein the lengths of paper toweling dispensed is programmable.

Yet another object of the invention is to provide a dispenser that monitors and collects data on usage and other information, etc.

The present invention is directed to an electronically controlled roll towel dispenser with a data communication system. The dispenser includes an optical transmitter in the form of a visible LED. The data transmitted by the dispenser can be received visibly through blinking LED data and through IR data packets. The addition of intelligent electronics into the roll towel dispenser creates a dispenser that automatically dispenses a predetermined length of paper toweling from the supply roll, monitors the status of the dispenser, and collects data to be transmitted to a receiver for analysis.

The data receiver is preferably a 3-Com Palm IIIx organizer with an integral infrared (IR) transceiver. The data transmitter is preferably an IR-emitting bi-color LED. The physical communication complies with the HP-SIR protocol. Data is transmitted only when the dispenser cover is open.

Exposed toweling is removed from the electronically controlled dispenser by the familiar pulling and tearing action. To accomplish this end, the dispenser implements an electromechanical trigger to translate the physical motion of towel tearing into an electrical signal. This signal directs a motorized drive mechanism to automatically dispense a fresh portion of towel. The electronic control of the electromechanical dispensing process is provided by an embedded microcontroller.

In addition to controlling the electromechanical dispense processes, the embedded microcontroller provides other useful benefits. It can effect a programmable dispense delay to reduce towel consumption and waste. The length of the towel portion distributed and the operating mode are also programmable operating parameters. Access to modify any of these parameters is automatically enabled whenever the dispenser cabinet cover is opened for periodic service. The microcontroller also has the capability to monitor and record important quantities and events. For example, the microcontroller can be programmed to automatically record the date and time of paper outage and refill, automatically monitor the usage of toweling to determine times of peek usage or total paper distributed from the dispenser, automatically provide a usage history to allow end users to plan maintenance and ordering of supplies, or automatically page or otherwise notify maintenance personnel of machine status. The dispenser can also be programmed to distribute only a predetermined amount of paper and to stop functioning once the dispenser has output that amount, or can be programmed to change the

amount of paper dispensed to each individual depending upon the time of day. Moreover, the dispenser can be used as a tool to acquire and store usage information to be used in research relating to usage of the dispenser.

The touchless dispenser can dispense any grade of roll towel paper including low basis weight paper. The battery driven internal feeding mechanism is designed to dispense any paper easily and smoothly. All the user does is tear off the paper and another length is automatically dispensed. The dispenser is powered with four D-size alkaline batteries. The unit is designed so that the batteries last from six to twelve months. There is even a low battery alert indicator.

The dispenser is fully programmable to dispense any length of paper, at any speed, and with any delay. The dispenser utilizes preset pushbuttons to select and adjust the parameters.

The dispenser's embedded micro-controller collects and stores usage data that can be retrieved easily. The LED transmitter sends control signals to a data collection device to tell if the dispenser is low on paper or if the batteries are low. The data can also be used to determine paper ordering patterns for the best roll towel inventory management. The dispenser can forecast when the paper or the batteries need changing so maintenance can be planned.

A primary advantage of the invention is providing means for digital data communication. This particular advantage becomes increasingly significant as the incorporation of embedded controllers into simpler and lower cost products continues to expand into the marketplace. Inevitably, as this trend continues, the cost of an IRDA-compatible communication port might approach 50% of the total manufacturing cost of a product's electronic control system.

The present embodiment is that of an improvement to the electronic control system of a battery-powered roll towel dispenser. This dispenser features a bi-colored LED used to indicate a variety of system conditions to the user or maintenance person. For example, failure modes are

typically indicated by red flashing patterns, while the relative battery condition is indicated by green, yellow or red flashes which represent good, marginal or low battery voltage, respectively. The color and pattern of each particular indicator signal is determined by the firmware programmed into the dispenser's embedded microcontroller IC. The dispenser is equipped with a transmitter, a visible red LED controlled by a microcontroller.

Various other features, objects, and advantages of the invention will be made apparent to those schooled in the art from the following detailed description and accompanying drawings.

Description of the Drawings

Fig. 1 is a perspective view of an electronically controlled roll towel dispenser constructed in accordance with the present invention;

Fig. 2 is a cross-sectional view taken along line 2-2 of Fig. 1 showing a cover interlock assembly;

Fig. 3 is a fragmentary cross-sectional view taken along line 3-3 of Fig. 2;

Fig. 4 is a perspective view of a dispenser assembly that is installed in the roll towel dispenser of Fig. 1;

Fig. 5 is an exploded perspective view of a portion of the dispenser assembly shown in Fig. 4;

Fig. 6 is a cross-sectional view taken along line 6-6 of Fig. 4;

Fig. 7 is an enlarged detailed view of a portion of the dispenser assembly shown in Fig. 6;

Fig. 8 is a cross-sectional view of a drive control assembly taken along line 8-8 of Fig. 4;

Fig. 9 is a fragmentary cross-sectional view of the drive gears of the drive control assembly taken along line 9-9 of Fig. 9;

Fig. 10 is a fragmentary cross-sectional view of a portion of the drive control assembly of Fig. 8 showing a trigger lever contacting a switch on a printed circuit board mounted in the drive control assembly;

Fig. 11 is a cross-sectional view similar to Fig. 10 showing the trigger lever depressing the switch on the printed circuit board;

Fig. 12 is a perspective view of a data communication system used in connection with the dispenser of the present invention;

Fig. 13 is a front plan view of a control panel that is mounted in the drive control assembly of Fig. 8;

Fig. 14 is a schematic diagram of the electrical circuitry on the printed circuit board mounted in the drive control assembly; and

Figs. 15-24 are flow diagrams illustrating operation of the dispenser in accordance with the present invention.

Detailed Description of the Invention

Referring first to Fig. 1, an electronically controlled paper towel dispenser 10 is shown constructed in accordance with the present invention. The paper towel dispenser 10 includes an outer housing 12 having a back panel 14 adapted to be fastened to a wall, right and left side panels 16 and 18, and a front cover 20. The front cover 20 is pivotally mounted to a lower portion of the housing 12 with hinge pins 22 extending outwardly on each side of the bottom of the cover 20 and into openings 24 on the bottom front of right and left side panels 16, 18. The front cover 20 is movable between a secured closed position and an open position as illustrated by arrow 26. The cover 20 is securable to an upper portion of the housing 12 by a latch 28 or other fastening device to maintain the front cover 20 in a closed position. The front cover 20 is

typically opened for servicing, collecting data, and loading roll paper into the dispenser 10. The roll consists of a continuous web of paper wound upon a hollow cylindrical core (not shown) that is installed in the dispenser. A discharge opening 30 for feeding a length of roll paper out of the dispenser 10 is located at the bottom of the housing 12 below the front cover 20. The housing 12 and front cover 20 are preferably made of plastic or any other type of lightweight material.

Figs. 2 and 3 illustrate a cover interlock assembly. The cover interlock is essentially a safety interlock which monitors the position of the front cover 20. The components of the cover interlock assembly are installed in a drive control assembly 32 mounted on the right side of the housing 12. The components include a cover lever 36 pivotally mounted to the drive control assembly 32 at a pivot point 44, the cover lever 36 having a tab 38 extending outwardly therefrom which contacts a bottom edge 25 of the cover 20 when in a closed position. The tab 38 extends through and is movable in a slotted opening 34 extending through the drive control assembly 32. The cover lever 36 further having a first end 40 for contacting a cover switch 52 on a printed circuit board 50 installed in the drive control assembly 32, and a second end 42 opposite the first end 40 connected to a first end of a helical spring 46. The helical spring 46 having a second end 49 connected to a rigid post 48 on the drive control assembly 32. The spring 46 biases movement of the cover lever 36 between the first end 40 depressing the cover switch 52 when the cover is in a closed position and not contacting the switch when the cover is in an open position as shown by arrow 54. When the cover 20 moves from an open position to a closed position, the bottom edge 25 of the cover 20 comes in contact with the tab 38 to close the switch 52.

Contacting the normally open switch 52 with the closed cover 20 provides an electrical signal to a microcontroller U2 on the printed circuit board 50 representing that the dispenser 10

is in a normal operating mode. When the cover 20 is open and the first end 40 of the cover lever 36 is not contacting the switch 52, the dispenser 10 is in a non-operating service mode as described in more detail below.

Fig. 4 is a perspective view of a dispenser assembly 56 that is installed in dispenser 10. The main components of the dispenser assembly 56 include the drive control assembly 32, a trigger assembly 58, and a feed drive assembly 60. A battery holder 62 for holding four D-size alkaline batteries is attached to the frame 57 of the dispenser assembly 56. The battery holder 62 is electrically connected to the drive control assembly 32 by wires 64 for powering a drive motor 66 and electrical components on the printed circuit board 50 installed in drive control assembly 32. The four alkaline batteries provide a nominal six-volt (6VDC) through wires to connector JP1 on the printed circuit board 50. A pair of arms 68 are pivotally mounted to and extend from the frame 57 of the dispenser assembly 56 for rotatably supporting a supply of roll paper 70, Fig. 6, in the dispenser housing.

Fig. 5 is an exploded perspective view of the dispenser assembly 56 illustrating connection of the drive control assembly 32 to the right side of the dispenser assembly 56, and the various components of the trigger assembly 58. The drive control assembly 32 provides the electromechanical power to the dispenser through the drive motor 66 and the electronics on the printed circuit board 50. The trigger assembly 58 provides an electrical signal to the microcontroller U2 representing the event of a length of towel being torn from the dispenser, the microcontroller then starts the drive motor after a pre-programmed delay to feed another length of roll paper out the discharge opening 30 of the dispenser.

The trigger assembly 58 includes a rotatable trigger arm 72 pivotally mounted to the frame 57 of the trigger assembly by right and left bearing blocks 78, 80 and right and left trip

brackets 74, 76. The trigger arm 72 is located behind a serrated cutting bar 88 for cutting a length of paper towel from the supply roll 70. The cutting bar 88 extends from the end of a bracket 90 fastened to the frame 57 of the dispenser assembly 56. The right side of the trigger arm 72 is connected to a spring biased trigger lever 84 through the right trip bracket 74. A return spring 82 is attached to the left trip bracket 76 to provide a balanced pivoting motion on both sides of the trigger arm.

Figs. 10 and 11 show the change in motion of trigger lever 84 when the trigger arm 72 is activated by a length of towel being torn from the dispenser, Fig. 11, and the trigger arm 72 in its normal position, Fig. 10. When the trigger arm 72 is activated, Fig. 11, trigger lever 84 moves upwardly causing a flat spring 96 attached to a first side 94 of the lever 84 to depress a trigger switch 98 mounted on the printed circuit board 50. Once the length of towel is torn from the cutting bar 88, the trigger arm 72 returns to its original position as shown in Fig. 10, releasing pressure from the switch 98. Actuation of the switch 98 causes the microcontroller U2 to initiate the drive motor 66 to feed another length of towel through discharge opening 30. Fig. 11 shows the trigger lever 84 depressing the switch 98 on the printed circuit board 50.

Figs. 6 and 7 illustrate the components of the feed drive assembly 60. Fig. 6 is a cross-sectional view through the dispenser assembly 56 before tearing a length of paper toweling from the supply roll. Fig. 7 depicts the feed drive assembly 60 after a length of paper toweling has been torn off the supply roll 70. As shown in Fig. 6, the roll paper 71 is fed around a control bracket, in between the nip of a feeder roller 102 and an idler roller 104, and behind trigger arm 72 and serrated cutting bar 88.

Figs. 8 and 9 illustrate the drive motor and gear assembly within the drive control assembly 32. A plurality of drive reduction gears are driven by the shaft output of the dive

motor. The gears transfer power from the drive motor 66 to a drive shaft connected to the drive gear. The drive motor is preferably a model RF-370-CA-261000 manufactured by Mabuchi Motor Company.

Fig. 12 illustrates the components of a digital data communication system of the present invention. The system includes an LED transmitter 120 mounted on the printed circuit board 50 of the drive control assembly32. The LED 120, preferably a bi-colored LED, is coupled to the microcontroller 50. The LED transmits visible and infrared (IR) data to a hand held receiver 122. The receiver 122 preferably includes an IR detector 124 and a display screen 126 for displaying data from the dispenser. As mentioned earlier, the data is transmitted by both visible light in the form of blinking green, yellow, or red colors from the LED and through IR signal transmission 128. The data is transmitted in packets, preferably in the form of HP-SIR protocol which is commonly used for IR data transfer between electronic devices. The receiver 122 is preferably a Palm IIIx organizer manufactured by 3Com Corporation, or another type of hand held device having an IR receiver.

Referring next to Fig. 13, a control panel 130 for the drive control assembly is shown. The control panel includes openings for the LED and the four pushbutton membrane switches. Three system parameters including towel length, dispense delay, and operating mode individually selectable by pressing the proper switch. Pressing one of the pushbutton switches will increment the value of the selected parameter. The factory default setting for each parameter are constant values programmed in memory. The last pushbutton is for resetting the system.

Except for the batteries and drive motor 66, all electrical components reside on the printed circuit board 50. Referring now to the schematic of electrical components shown in Fig

14, the connector JP1 provides electrical connection to a power supply through two wires 64. The power supply preferably comprises four D-size alkaline batteries which supply power to the drive motor 66 and the printed circuit board 50. The nominal voltage of each alkaline battery ranges from one and one-half volts (1.5V) for a fresh battery, to an end of service voltage of approximately nine-tenths of a volt (0.9V). This provides a power supply voltage ranging from 3.6V to 6.0V. The drive motor 66 interconnects to the printed circuit board at connectors W1 and W2. W1 connects to the supply voltage and W2 connects to a digital output circuit from microcontroller U2 labeled MOTOR, which provides gating voltage for transistor Q3. A high MOTOR output turns Q3 on, allowing current to flow from the power supply through the drive motor 66 to GND. A low MOTOR output turns Q3 off, blocking motor drive current. The JP2 connector allows for serial programming of the microcontroller U2.

Moving now to the components mounted on the printed circuit board 50, the primary power supply bus VP branches to a voltage regulator circuitry comprising U1 for supplying the proper voltage to the control circuitry as VCC. This reduced and regulated voltage improves the efficiency and extends the life of the alkaline batteries. The supply voltage VP is sampled by circuitry comprising transistor Q1 and a voltage divider formed by resistors R3, R4 and capacitor C4. With Q1 conducting, a scaled representation of the supply voltage VP is presented at the junction of resistors R3 and R4.

The main component on the printed circuit board 50 is the microcontroller U2 which includes RAM for storage of variable data, and is connected to a EEPROM U3 for storage of instructions and constant data. Peripheral circuitry supporting U2 include a crystal oscillator CR1 and reset circuitry comprising R2, C3 and D2. The microcontroller U2 is preferably a

PIC16C62x manufactured by Microchip, Inc. Following is a summary of the microcontroller control circuits.

The analog comparator input AN0 is sourced by the voltage divider circuit of Q1, R3 and R4. When activated by control output Pmgr the voltage divider provides a scaled representation of the supply voltage VP at Vsamp.

Digital output RA1 controls a power management circuit labeled Pmgr comprising R6, R7, R8 and Q2. This circuit is used to activate the higher power circuits on an as needed basis.

The digital output circuit RA2, labeled RED, provides drive current to the red diode in an integrated bi-color LED. The digital output circuit RA3, labeled GREEN, provides drive current to the green diode in the bi-color LED. Circuit RA4 is a digital input labeled TACH. The TACH circuit provides a voltage proportional to the light transmitted between the LED and phototransistor of OP1. The apertures in the rotating encoder __ of drive motor 66 alternately pass or block the beam of IR light between the LED and the phototransistor in OP1, switching the voltage at RA4 from binary high to binary low.

Circuits RB1, RB2, RB3, RB6 and RB7 are digital inputs from a matrix of pushbutton switches labeled K1 LENGTH, K2 DELAY, K3 MODE and K4 PRESET.

Circuit RB5 is a digital input labeled TRIGGER from trigger switch SW1. SW1 is a normally open switch that closes when the trigger is activated. Circuit RB4 is a digital input labeled COVER from the cover switch SW2. SW1 is a normally open switch that closes when the trigger is activated. SW2 is a normally open switch that closes when the cover interlock is activated.

Figs. 15-24 are flow diagrams illustrating operation of the dispenser in accordance with the present invention. Process control begins with the main loop flow chart of Fig. 15.

Following power-up and a system reset 150, the initial state 152 of the dispenser is established. Control then enters a polling loop. Here, the primary modes of system operation are represented as power manager 154, error monitor 156, service mode 158, and dispense process 160. This sequence loops indefinitely, or until a process request is detected. The loop represents the normal idling state of the system as it awaits some kind of outside interaction or interrupt.

The power manager 154 extends battery life by putting the system into a sleep mode after a certain amount of time. The system wakes up from the sleep mode when it receives an interrupt. The next process in Fig. 15 is the error monitor 156 of Fig. 16.

In the error monitor process, the system is monitored for a system error 162. If no error is detected, then the system returns to the main loop. However, if an error is detected and the cover is closed 164, the error status is indicated as shown in Fig. 17 by the LED transmitting the error status data 168 and initiating a two second delay 170. The transmitted data may be received by a receiving device.

The next process in the main loop is the service mode. The dispenser cover must be open for the dispenser to be in service mode. The first process in service mode is the status indicator process of Fig. 19. In the status indicator process, the battery voltage is checked. If the battery voltage is less than 10% of full voltage 188, then the Red LED blinks on and off and transmits data that the batteries should be replaced 192. If the battery voltage is less than 20% of full voltage 190, then the Yellow LED blinks on and off and transmits data that the batteries are low and should be replaced soon 194. If the battery voltage is greater than 20% of full voltage 190, then the Green LED blinks on and off and transmits data that the batteries are good and do not need to be replaced 196.

Returning to the service mode of Fig. 18, the next step in the process is to scan and decode the pushbutton keys 174 on the control panel to determine if any have been depressed 176. If any of the keys have been depressed, then the process shifts to the command processor 178 in Fig. 20. If the first key has been pressed 204, then the next towel length preset is selected 212 and the control variables are updated in memory 220. If the key is not released 222, review the color-coded selection indicator 224. If the second key has been pressed 206, then the next dispense delay preset is selected 214 and the control variables are updated in memory 220. If the key is not released 222, review the color-coded selection indicator 224. If the third key has been pressed 208, then the next operating mode preset is selected 216 and the control variables are updated in memory 220. If the key is not released 222, review the color-coded selection indicator 224. If the fourth key has been pressed 210, then the next preset menu is selected 218 and the control variables are updated in memory 220. If the key is not released 222, review the color-coded selection indicator 224.

Returning again to the service mode of Fig. 18, the system checks to see if the cover is closed 180 by checking at the cover interlock. If the cover is closed, the error status is updated 182 as shown in Fig. 21.

In the update error status process of Fig. 21, the trigger is checked to determine if it is inactive 226. If the trigger is inactive, then a trigger jam error is cleared 228. If the trigger is not inactive, then a trigger jam error is flagged 238. The next step involves checking the battery voltage 230. If the voltage is good, then a low battery error is cleared 232. If the voltage is not good, then a low battery error is flagged 238. The system may also clear a stall error 234 or an overload error.

Returning again to the service mode process of Fig. 18, the system makes a final check to determine if an error was flagged 184. If not, a dispense is requested 186. The next process is the dispense process of Fig. 22.

In the dispense process, the system checks for a flagged error 242 and a dispense request 244. If a dispense has been requested by an activated trigger, the system checks to determine if the trigger has been released 246. If not, the system checks for a trigger timeout 25. If there has been a trigger timeout, then a trigger jam error is flagged 254. If the trigger was released, then the system initiates a dispense delay 248 and a feed cycle 250.

The feed cycle shown in Fig 23 is started by initializing the feed system 256. Next, test parameters are activated 258. The test parameters process is shown in Fig. 24. The system checks to see if the cover is closed 270. If the cover is open, the process is aborted 287 and returns to the main loop, Fig. 15. If the cover is closed, then the system checks for an inactive trigger 272. If the trigger is not inactive, a dispense request is flagged 280. If the trigger is inactive, then the system checks battery voltage 274. If the battery voltage is low, then a low battery error is flagged 282. If the voltage is good, the system checks for tach pulses 276 from the drive motor. If there are no tach pulses, then a stall error is flagged 284. If the tach pulses are present, then the system checks for the correct RPM of the drive motor 278. If the RPM is not in range, then an overload error is flagged 286. The process jumps back to the feed cycle of Fig. 23. If there was an abort flagged 260, then the feed system is shutdown 268 and the process goes back to the main loop. If an abort was not flagged, then the RPM 262 and angular displacement 264 of the drive motor are monitored by the feed system to determine feeding speed and towel length, respectively. The data is recorded in memory 266. The feed system is shutdown and the process jumps to the main loop.

While the invention has been described with reference to preferred embodiments, those skilled in the art will appreciate that certain substitutions, alterations, and admissions may be made without departing from the spirit of the invention. Accordingly, the foregoing description is meant to be exemplary only and should not limit the scope of the invention set forth in the following claims.

Claims

We claim:

1. An apparatus for dispensing a web of sheet material from a continuous roll, the apparatus comprising:

a housing having a back panel, a discharge opening and a front cover pivotally connected to a bottom portion of the housing for movement between an open position and a closed position;

a support for rotatably supporting a roll of sheet material;

a feed mechanism for advancing the sheet material;

a motor for driving the feed mechanism; and

a controller for powering the motor to drive the feed mechanism to dispense a length of sheet material from the housing.

2. The apparatus of claim 1 wherein the feed mechanism includes a feed roller driven by the motor and an opposing pressure roller between which the sheet material is passed.

3. The apparatus of claim 2 wherein the feed mechanism further includes a drive gear and a rotatable axle to support the feed roller and drive gear.

4. The apparatus of claim 1 wherein the controller includes an encoder for determining the predetermined length of sheet material .

5. The apparatus of claim 1 further comprising a trigger mechanism for activating the controller.

6. The apparatus of claim 5 wherein the trigger mechanism activates the controller when a length of sheet material is removed from the continuous roll.

7. An dispenser for flexible sheet material comprising:

a housing having a back panel, a discharge opening and a front cover pivotally connected to a bottom portion of the housing for movement between an open position and a closed position;

a support for rotatably supporting a roll of sheet material;

a feed mechanism for advancing the sheet material;

a motor for driving the feed mechanism;

a controller for powering the motor to drive the feed mechanism to dispense a length of sheet material from the housing; and

a transmitter for transmitting data.

8. A method of dispensing flexible sheet material from a dispenser, the method comprising the steps of:

activating a motor to advance a predetermined length of sheet material from a dispenser;

controlling the length of sheet material being dispensed;

controlling the dispense delay; and

tearing the length of sheet material from the dispenser.

9. The method of claim 8 wherein the motor is activated by a trigger mechanism.

a housing having a back panel and a front cover

10. A data comunication system for use with a dispenser, the system comprising:

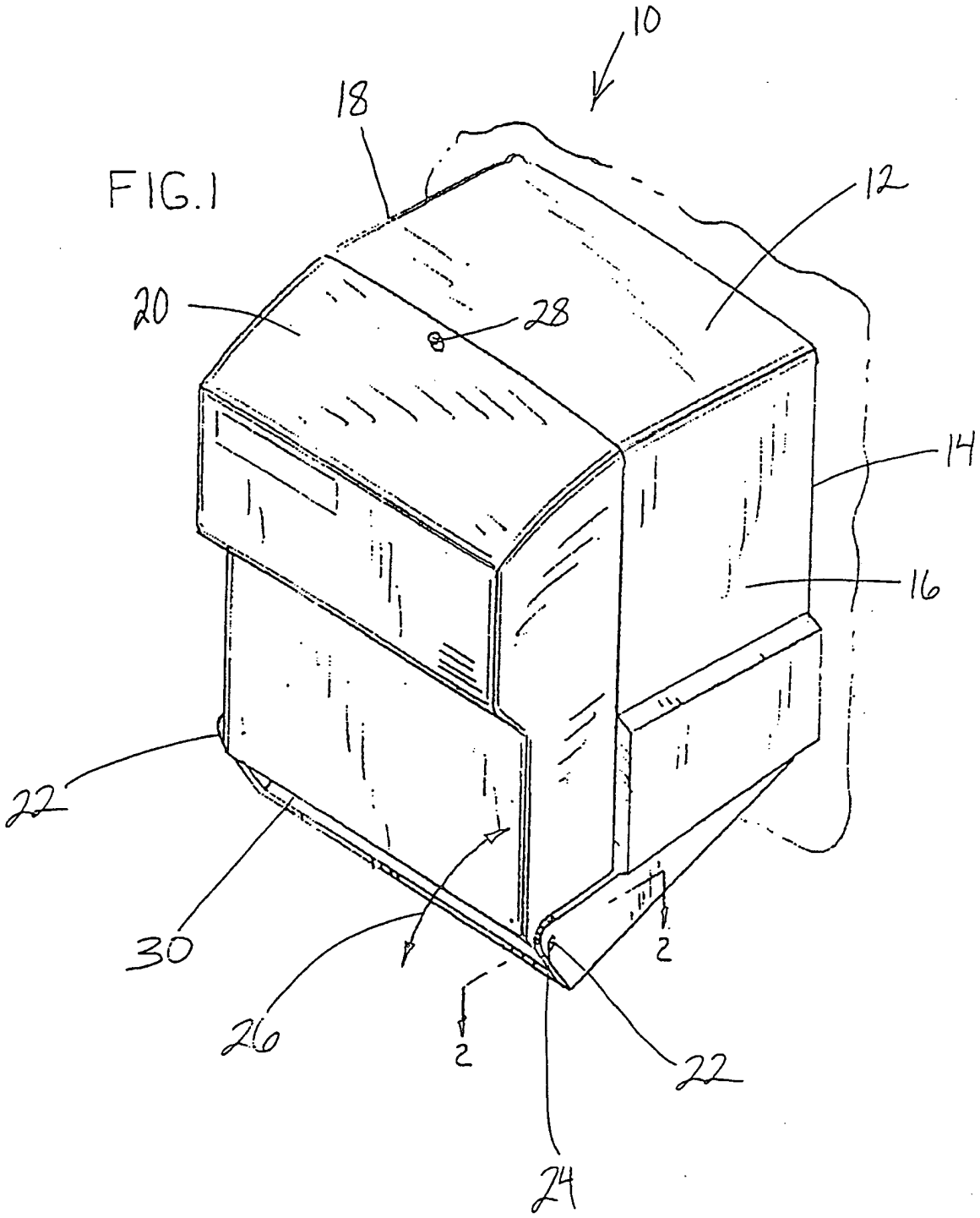
a transmitter connected to the dispenser for transmitting data;

a controller for controlling the transmitter; and

a receiver for receiving data from the transmitter.

5

FIG.1



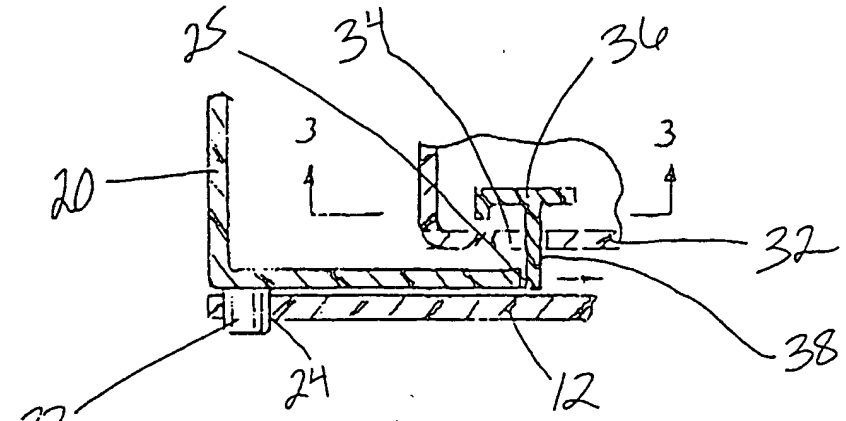

25
34
36
3
3
20
32
38
22
24
12

FIG. 2

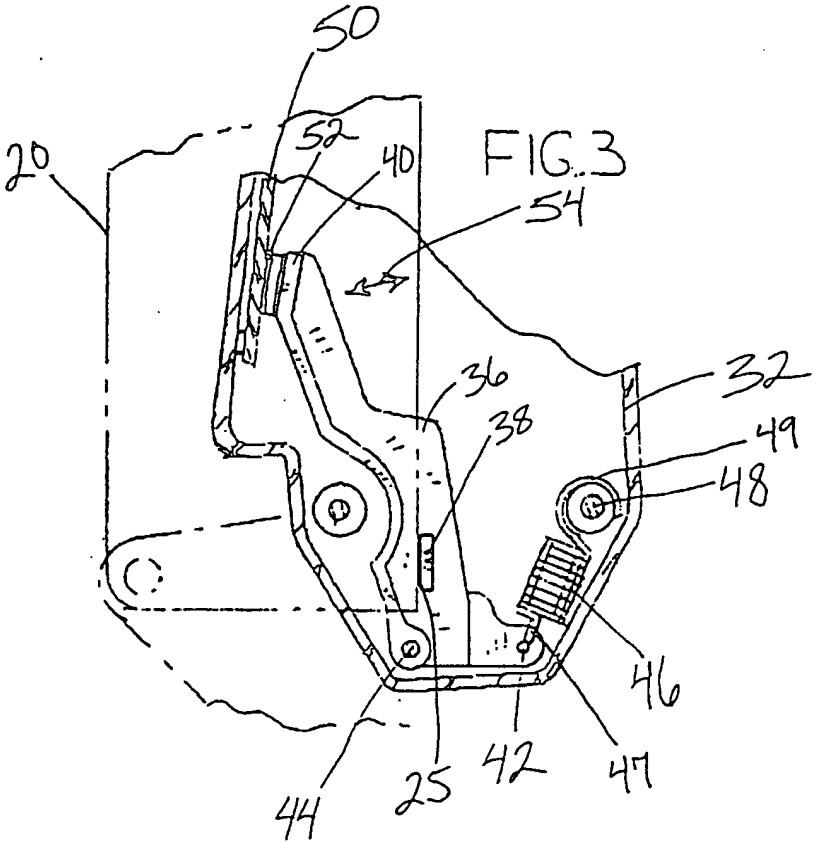
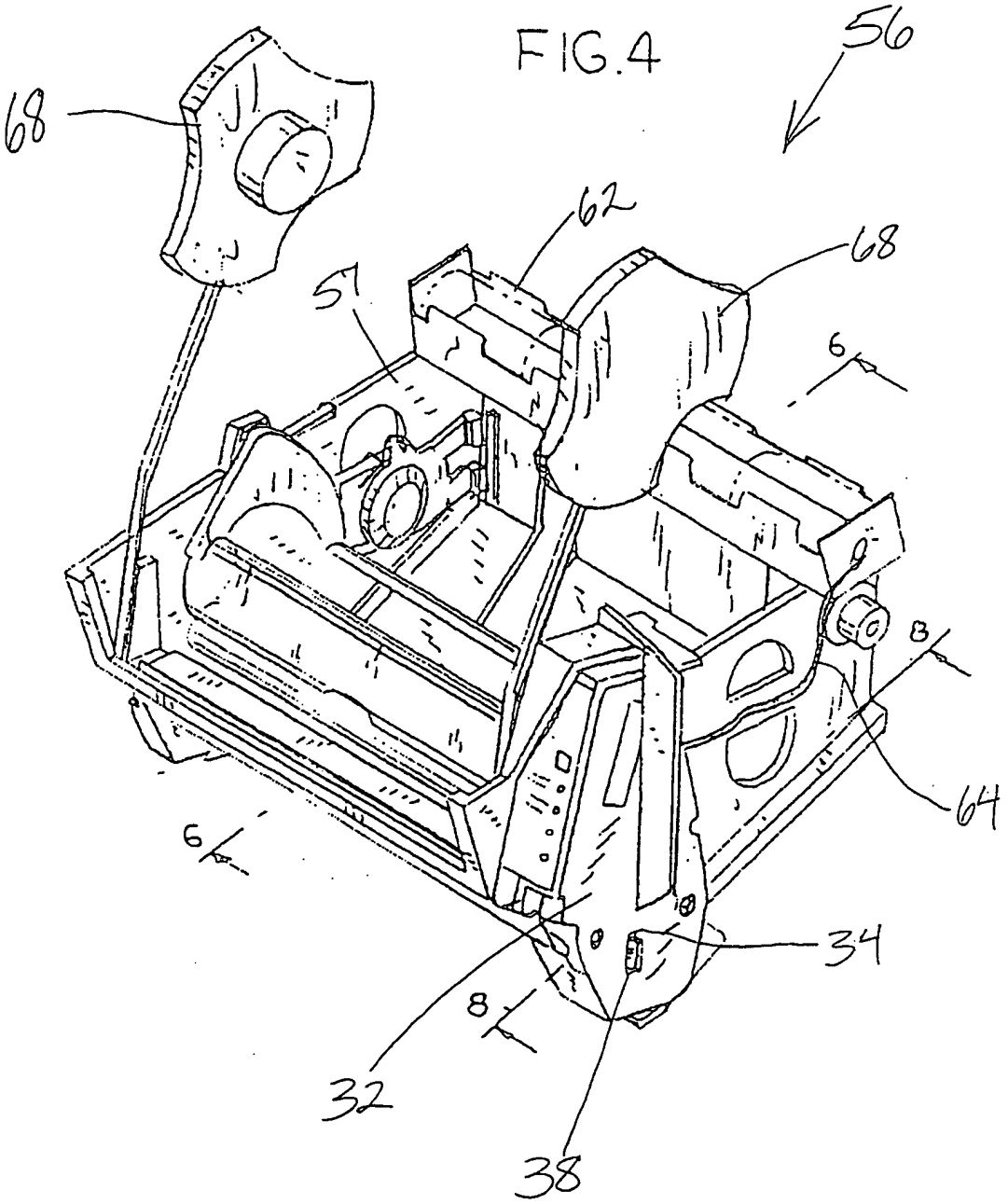

50
52
40
20
54
32
36
38
49
48
46
44
25
42
47

FIG. 3

FIG.4



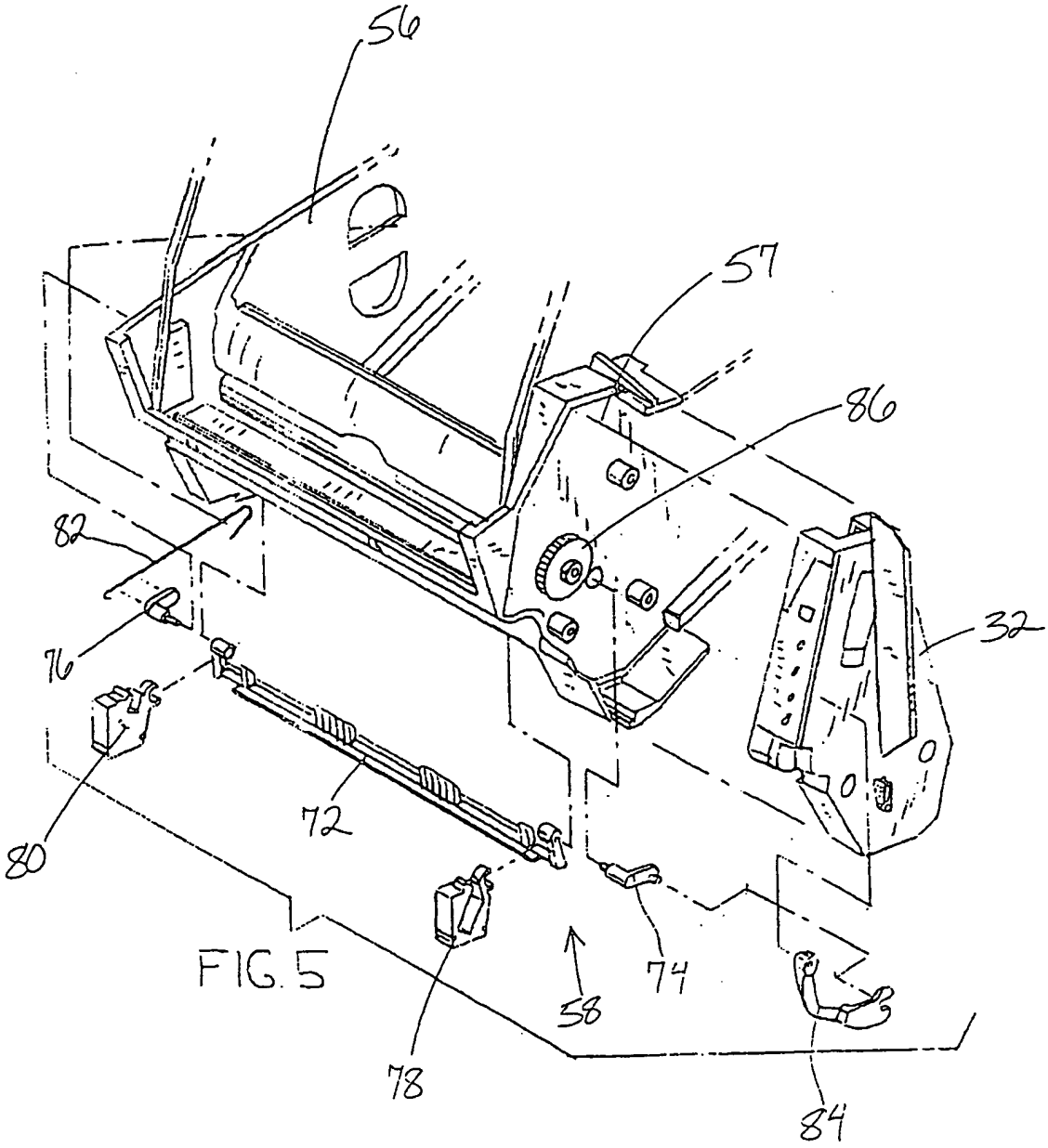
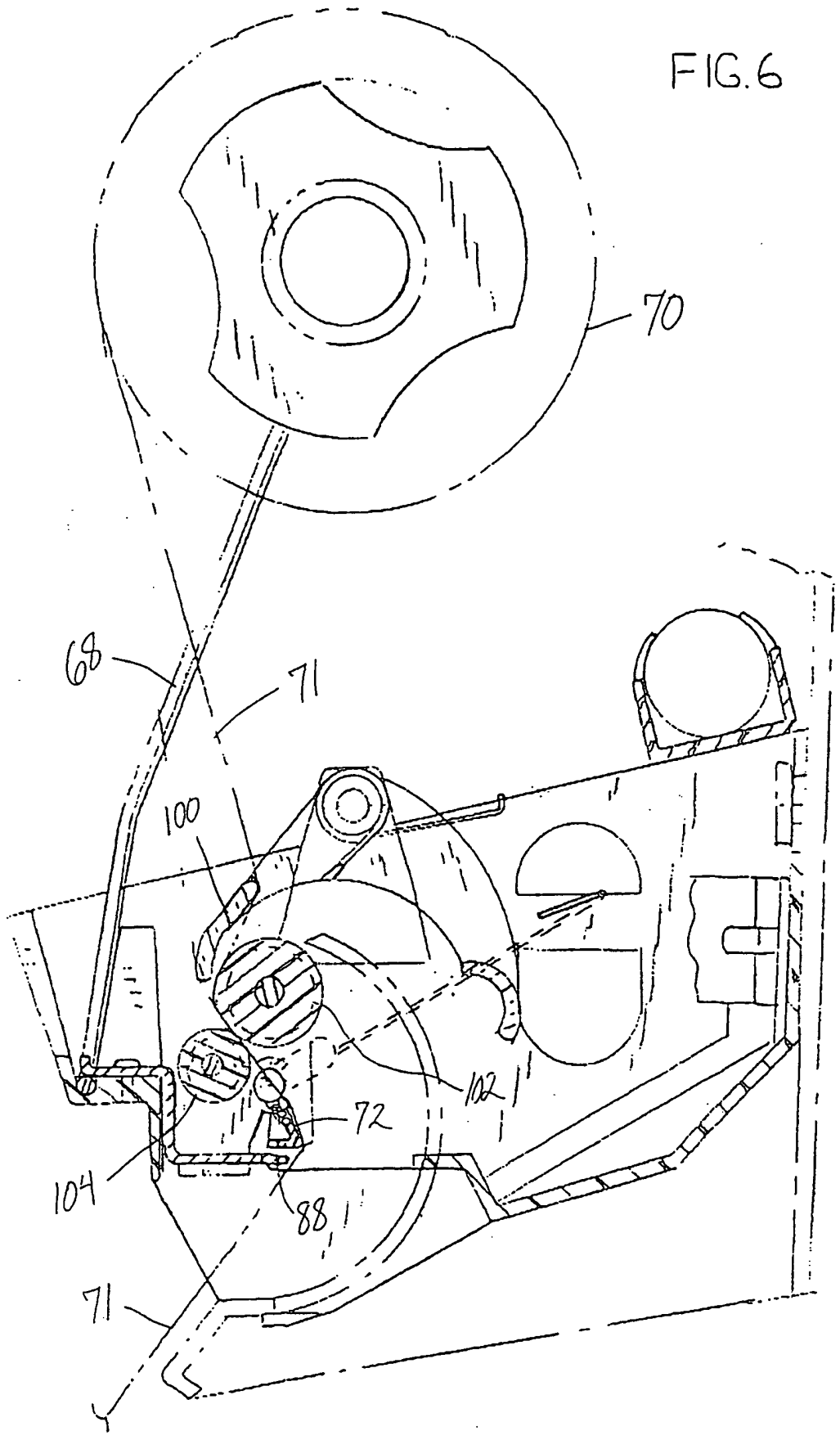


FIG. 5

FIG.6



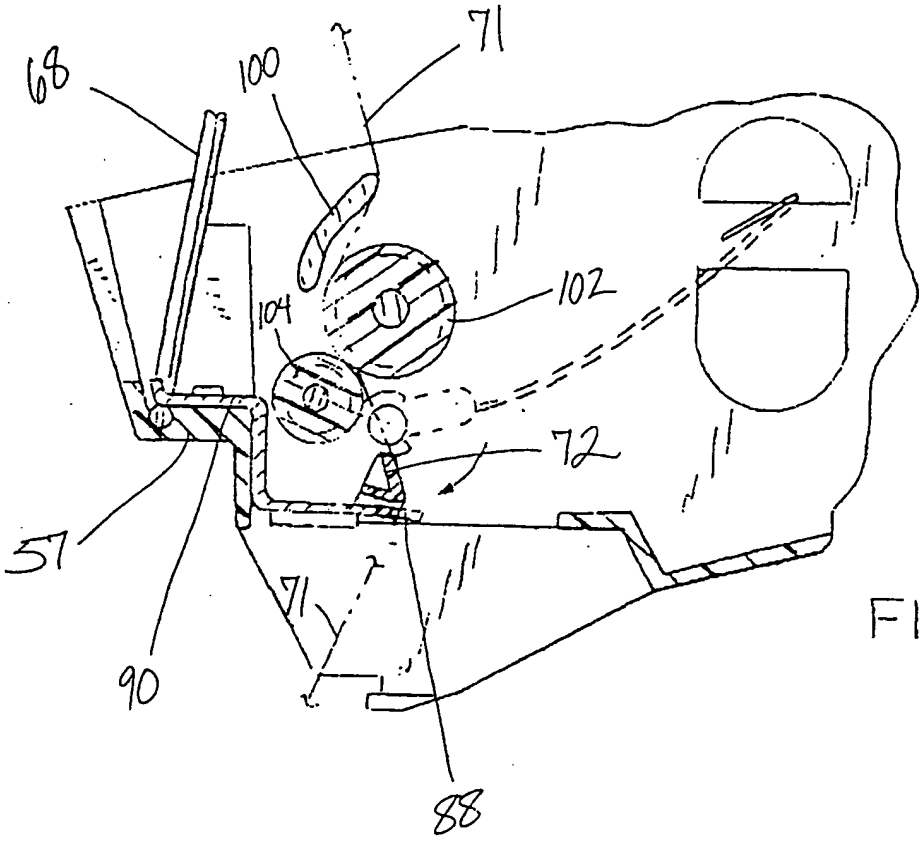


FIG 7

FIG.8

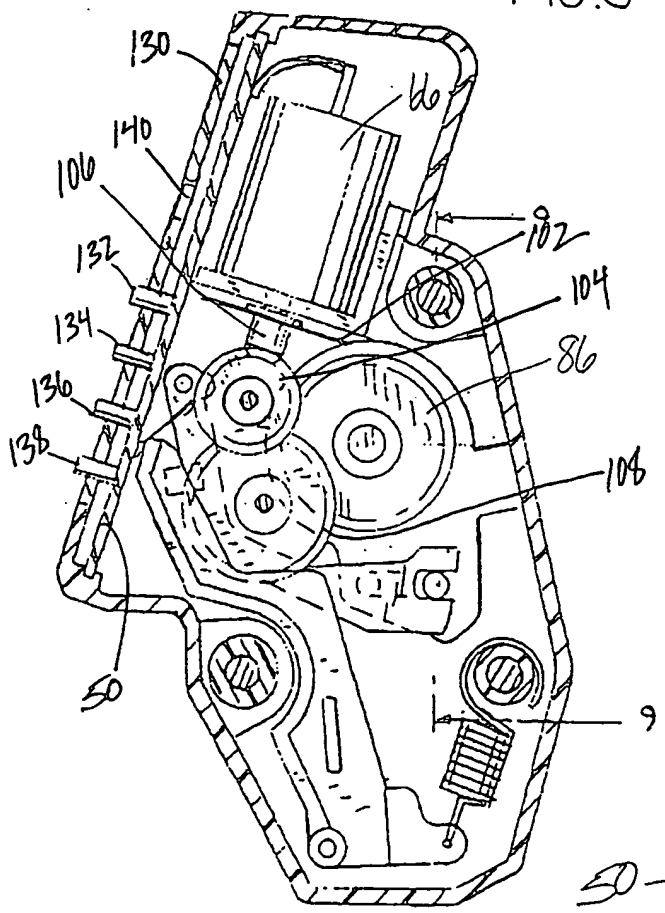
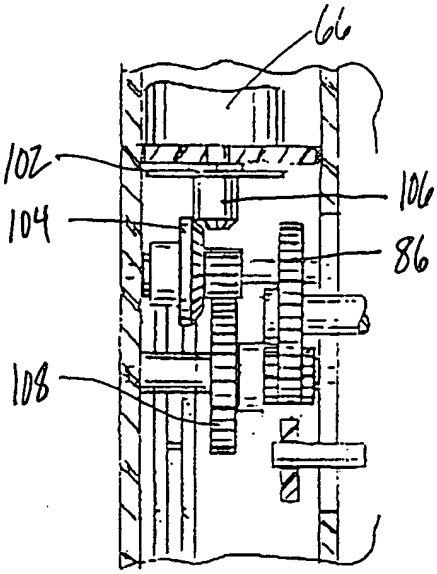


FIG.9



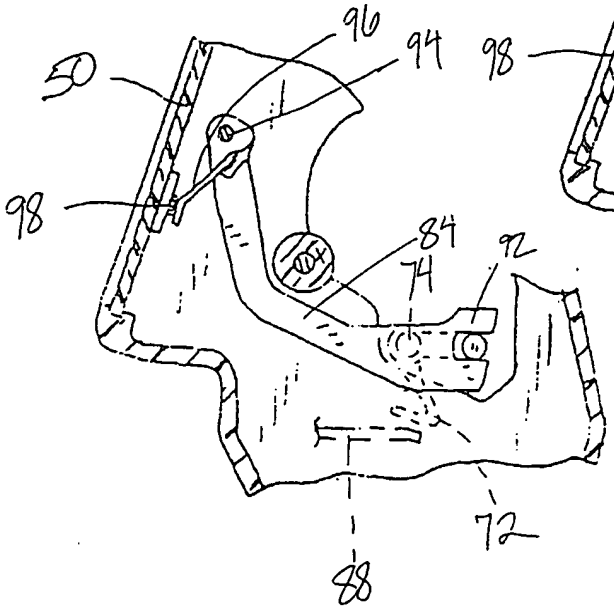


FIG.10

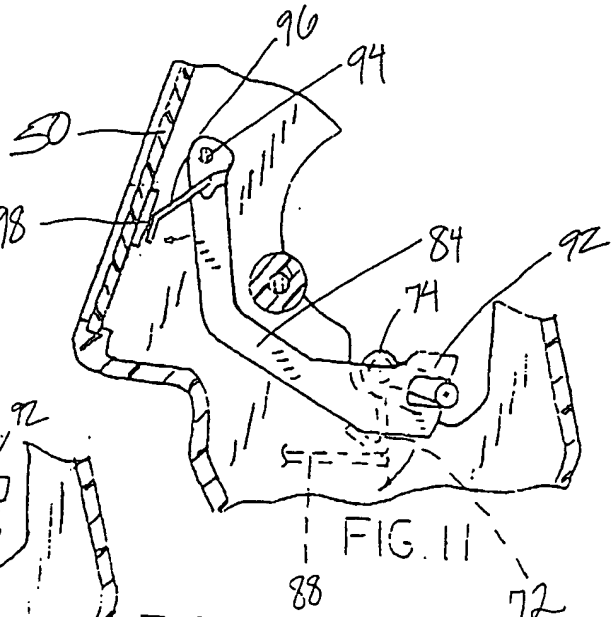


FIG.11

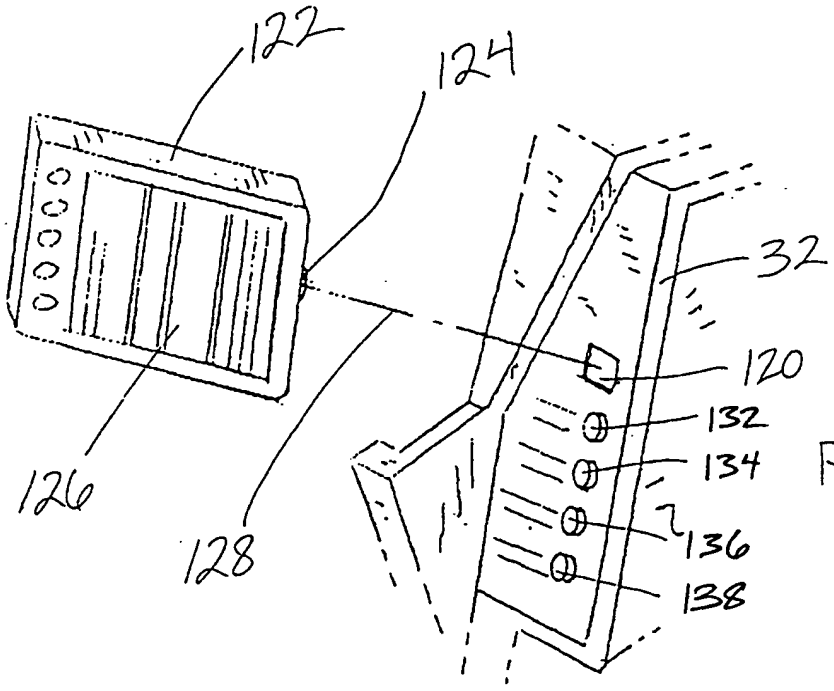


FIG. 12

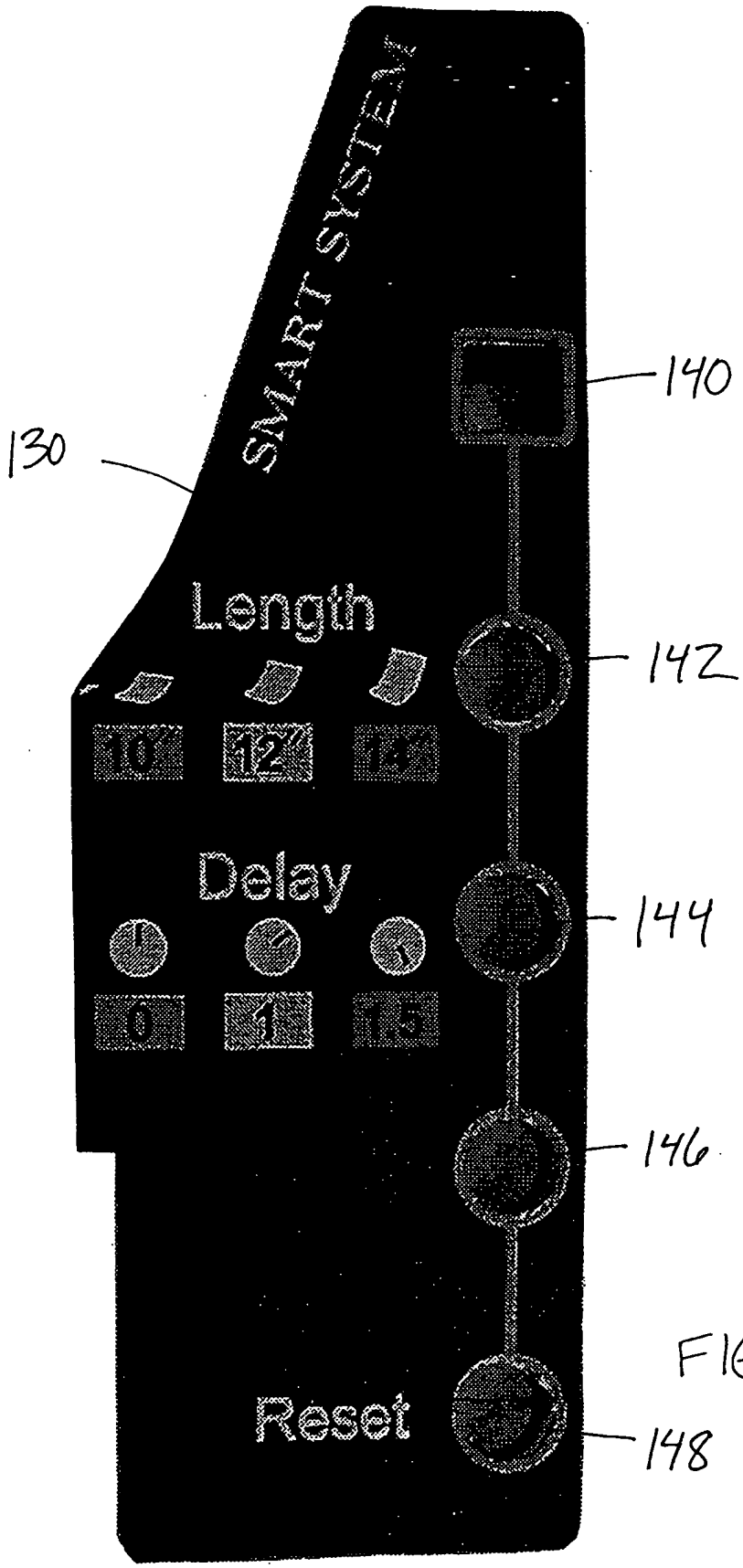

SMART SYSTEM
130
140
Length
10
12
14
142
Delay
0
1
.5
144
146
Reset
148

FIG. 13

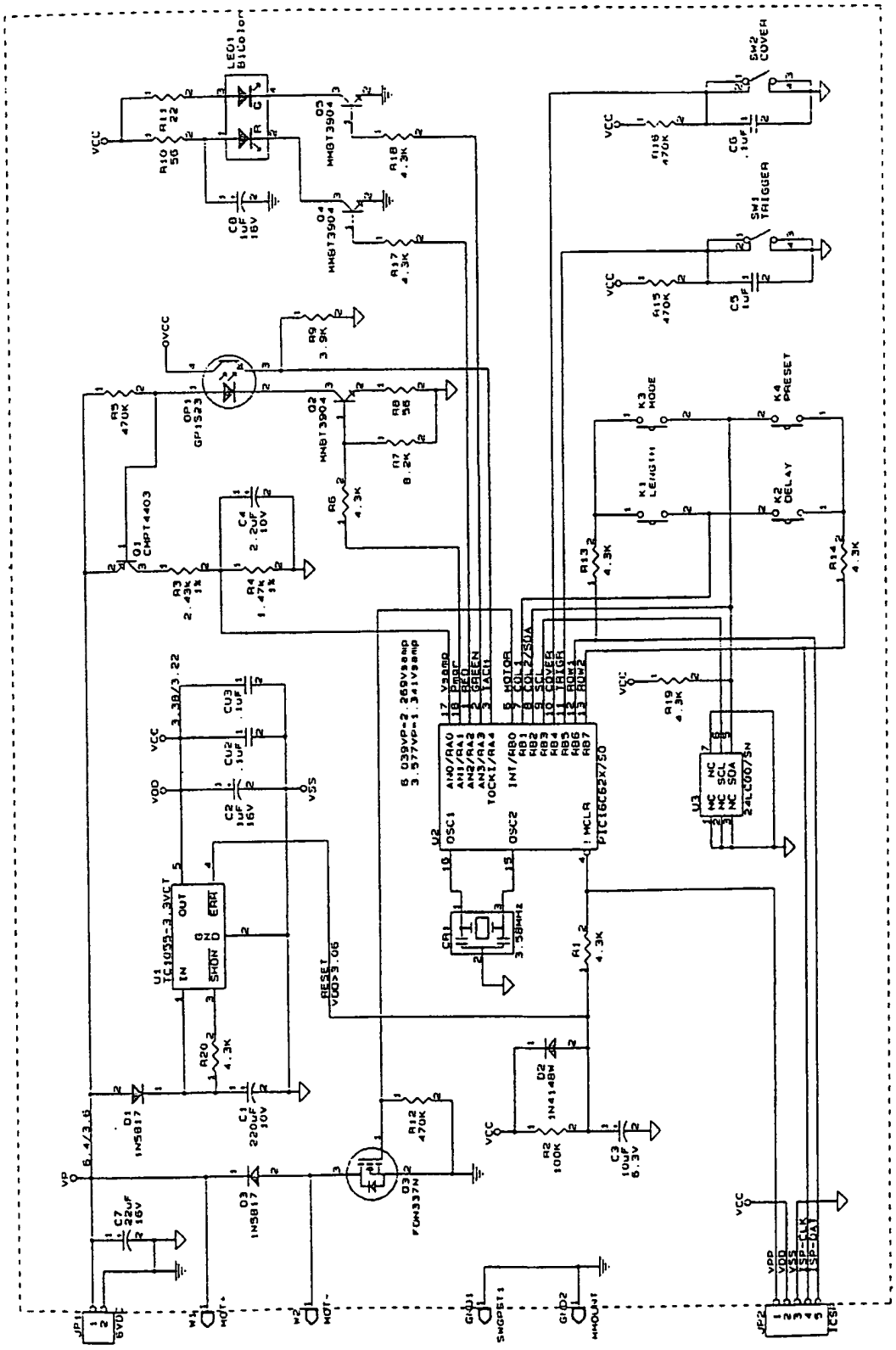
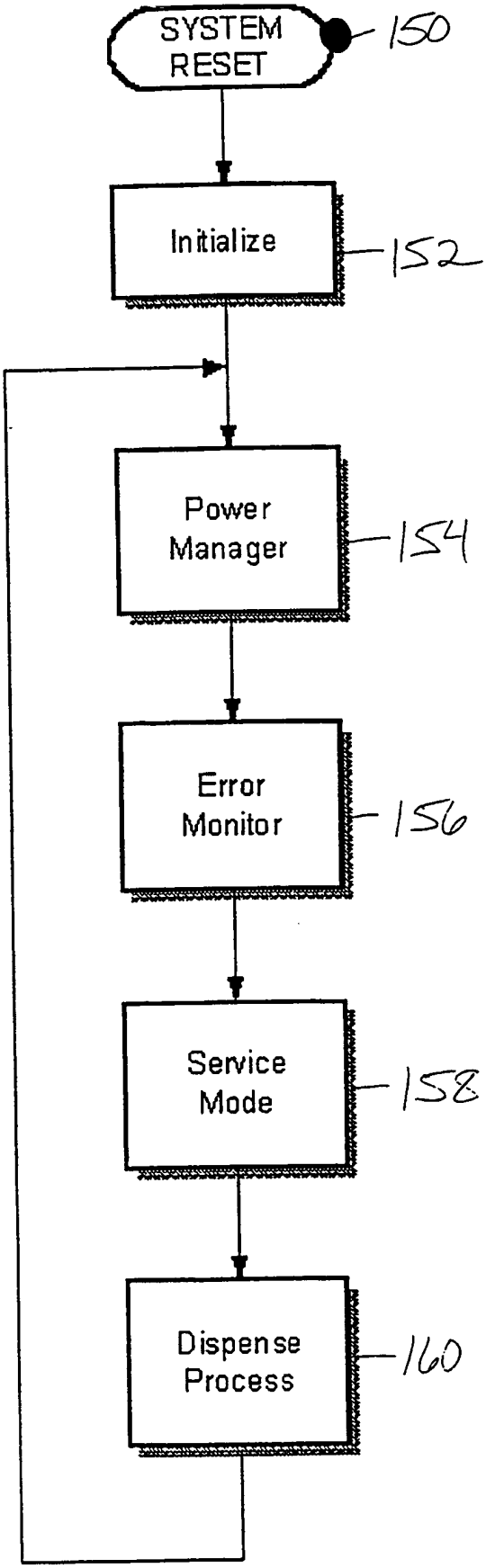


FIG. 14



Main Loop

FIG. 15

Error Monitor

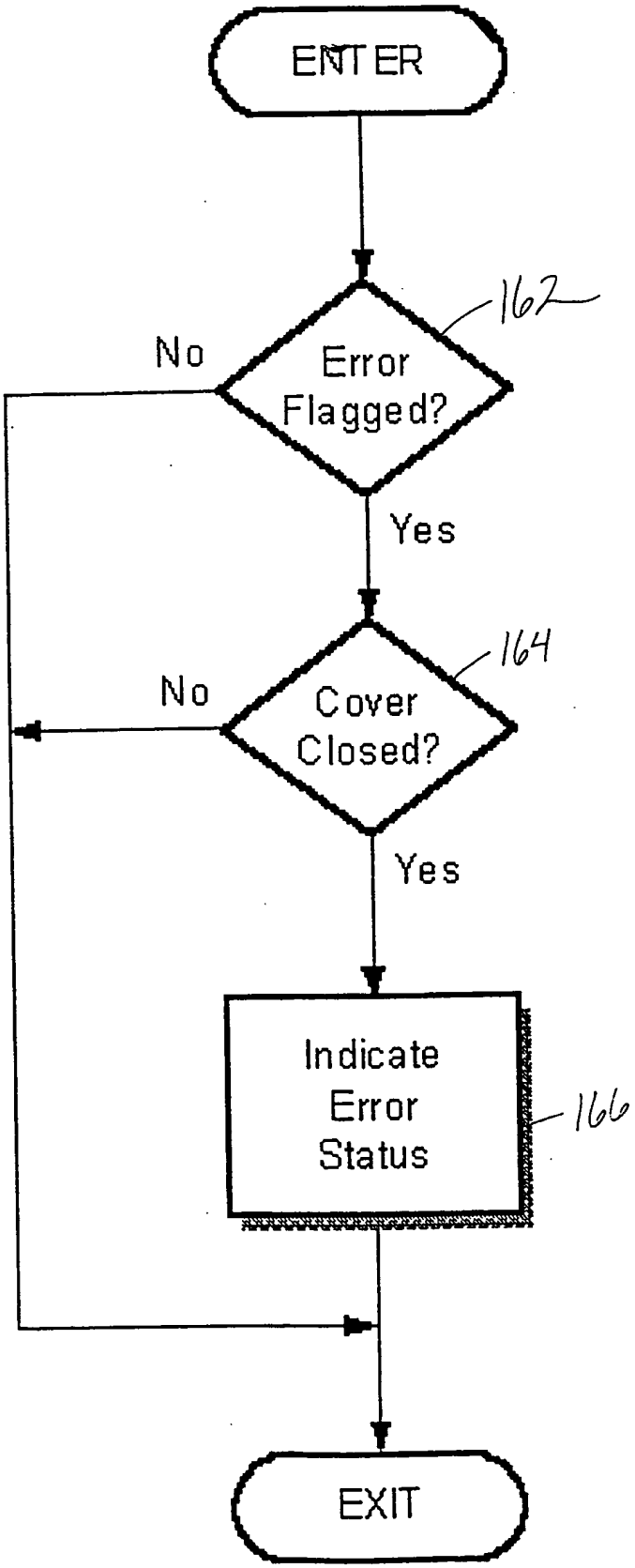


FIG. 16

Error Monitor

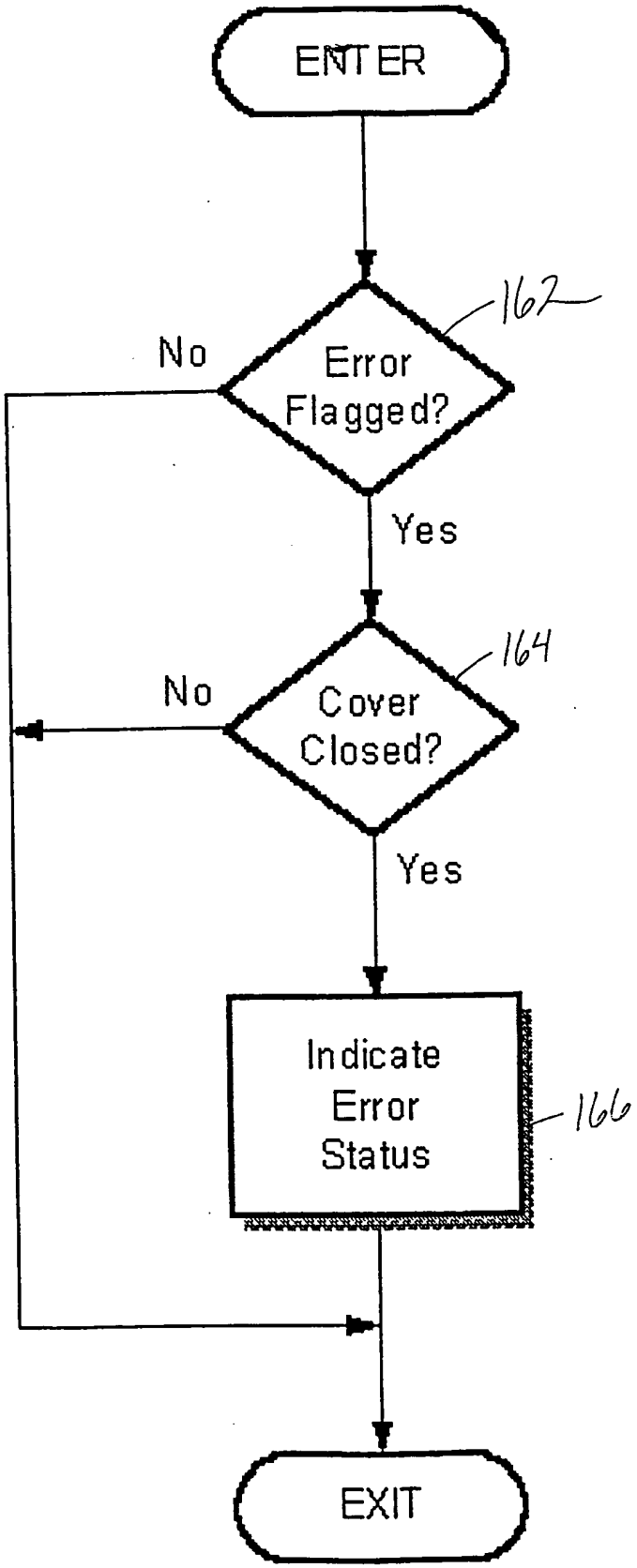
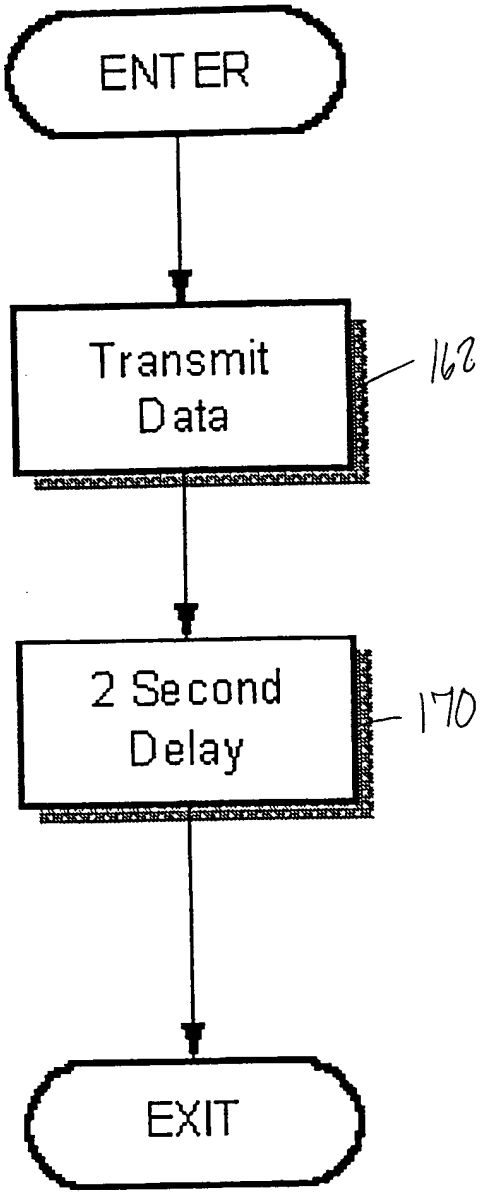


FIG. 16



Indicate Error Status

FIG. 17

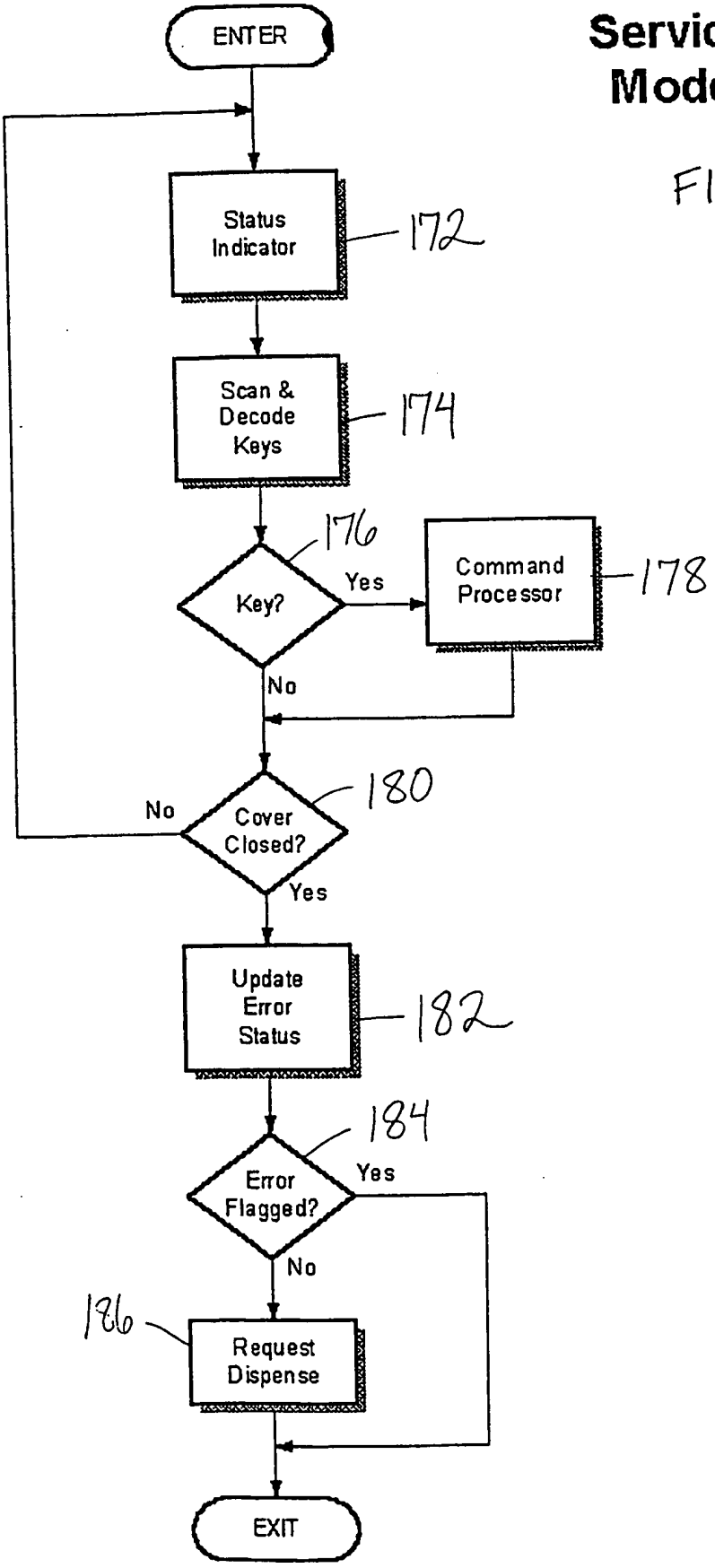

Service Mode
ENTER
Status Indicator
172
Scan & Decode Keys
174
176
Key?
Yes
Command Processor
178
No
No
Cover Closed?
180
Yes
Update Error Status
182
184
Error Flagged?
Yes
No
186
Request Dispense
EXIT

FIG. 18

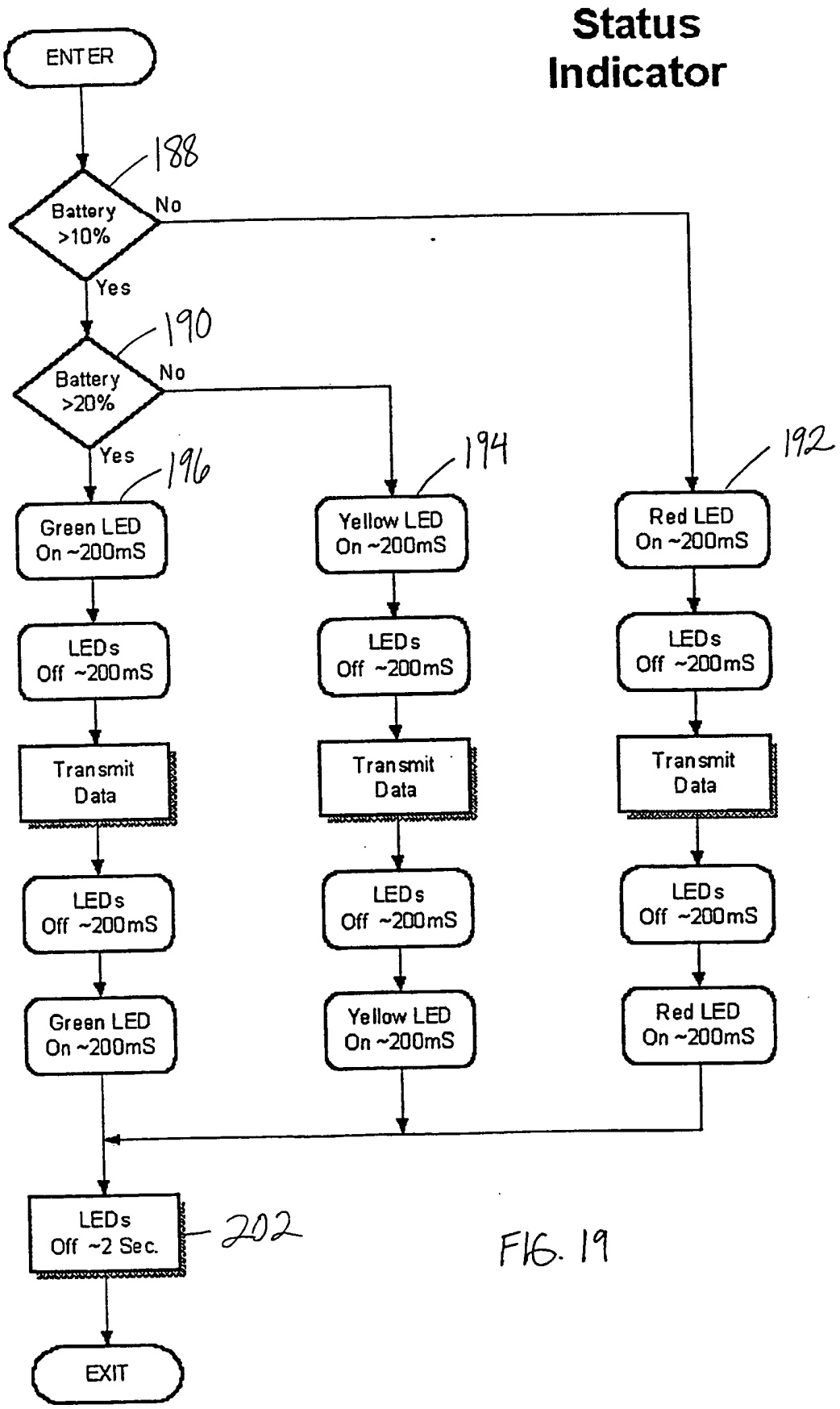

Status Indicator
ENTER
188
Battery >10%
No
Yes
190
Battery >20%
No
Yes
196
194
192
Green LED On ~200mS
Yellow LED On ~200mS
Red LED On ~200mS
LEDs Off ~200mS
LEDs Off ~200mS
LEDs Off ~200mS
Transmit Data
Transmit Data
Transmit Data
LEDs Off ~200mS
LEDs Off ~200mS
LEDs Off ~200mS
Green LED On ~200mS
Yellow LED On ~200mS
Red LED On ~200mS
LEDs Off ~2 Sec.
202
EXIT

FIG. 19

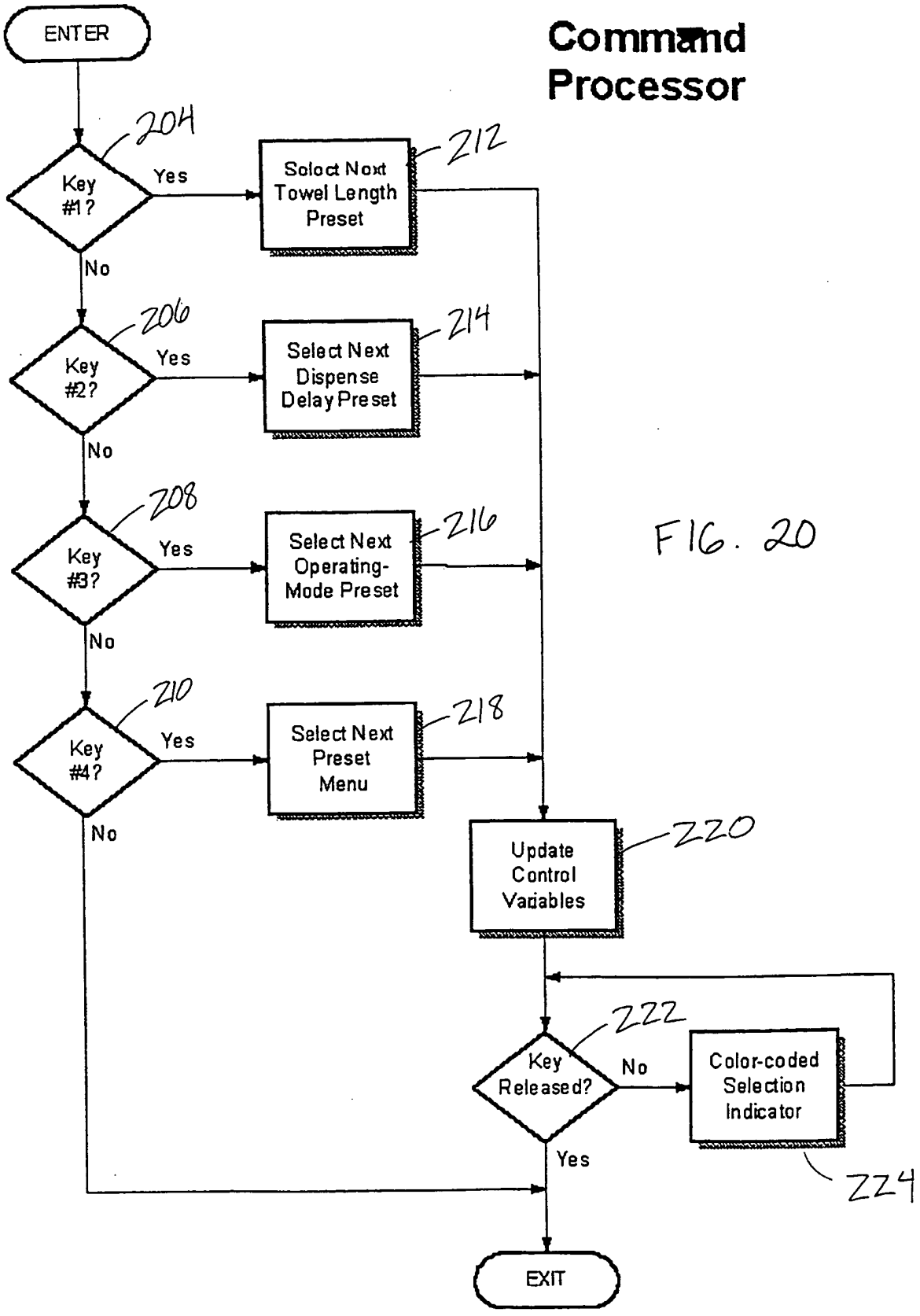

Command Processor
ENTER
204
Key #1?
Yes
212
Select Next Towel Length Preset
No
206
Key #2?
Yes
214
Select Next Dispense Delay Preset
No
208
Key #3?
Yes
216
Select Next Operating-Mode Preset
No
210
Key #4?
Yes
218
Select Next Preset Menu
No
220
Update Control Variables
222
Key Released?
No
Color-coded Selection Indicator
224
Yes
EXIT

FIG. 20

Update Error Status

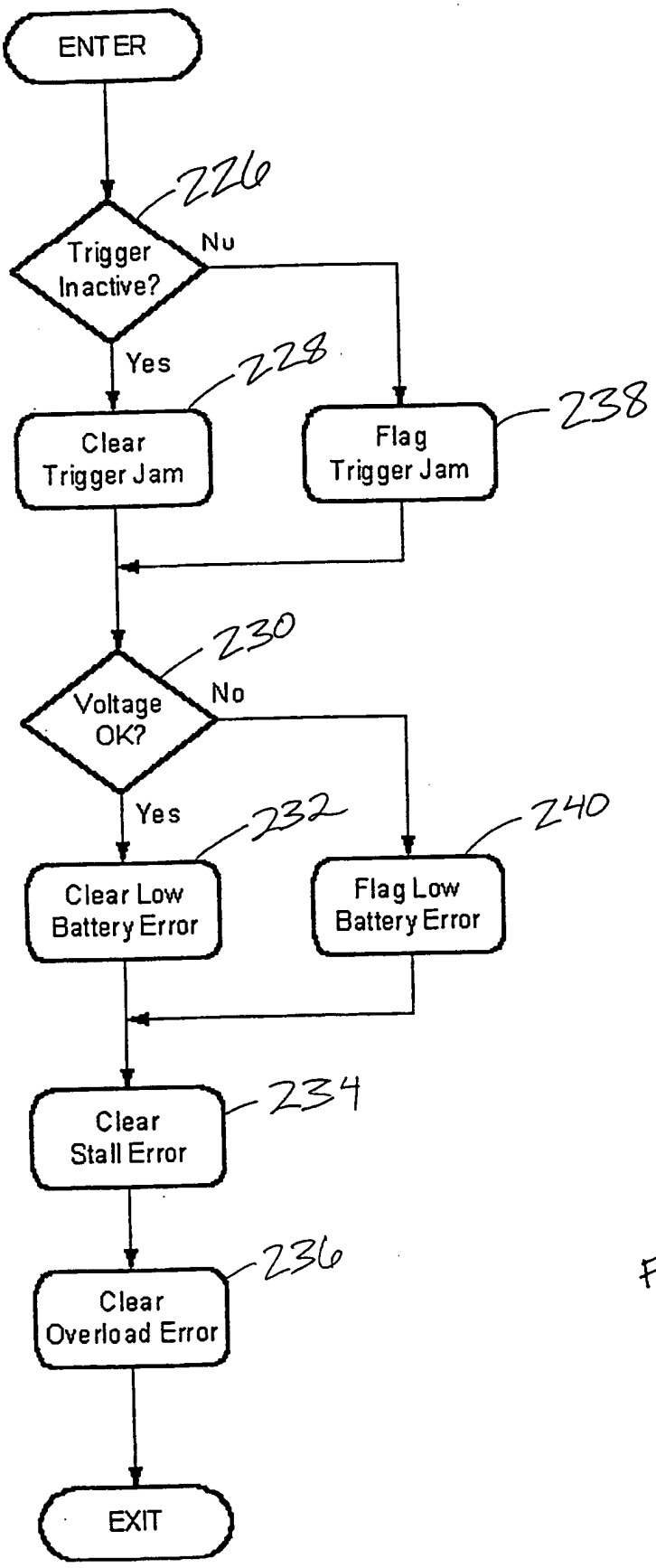
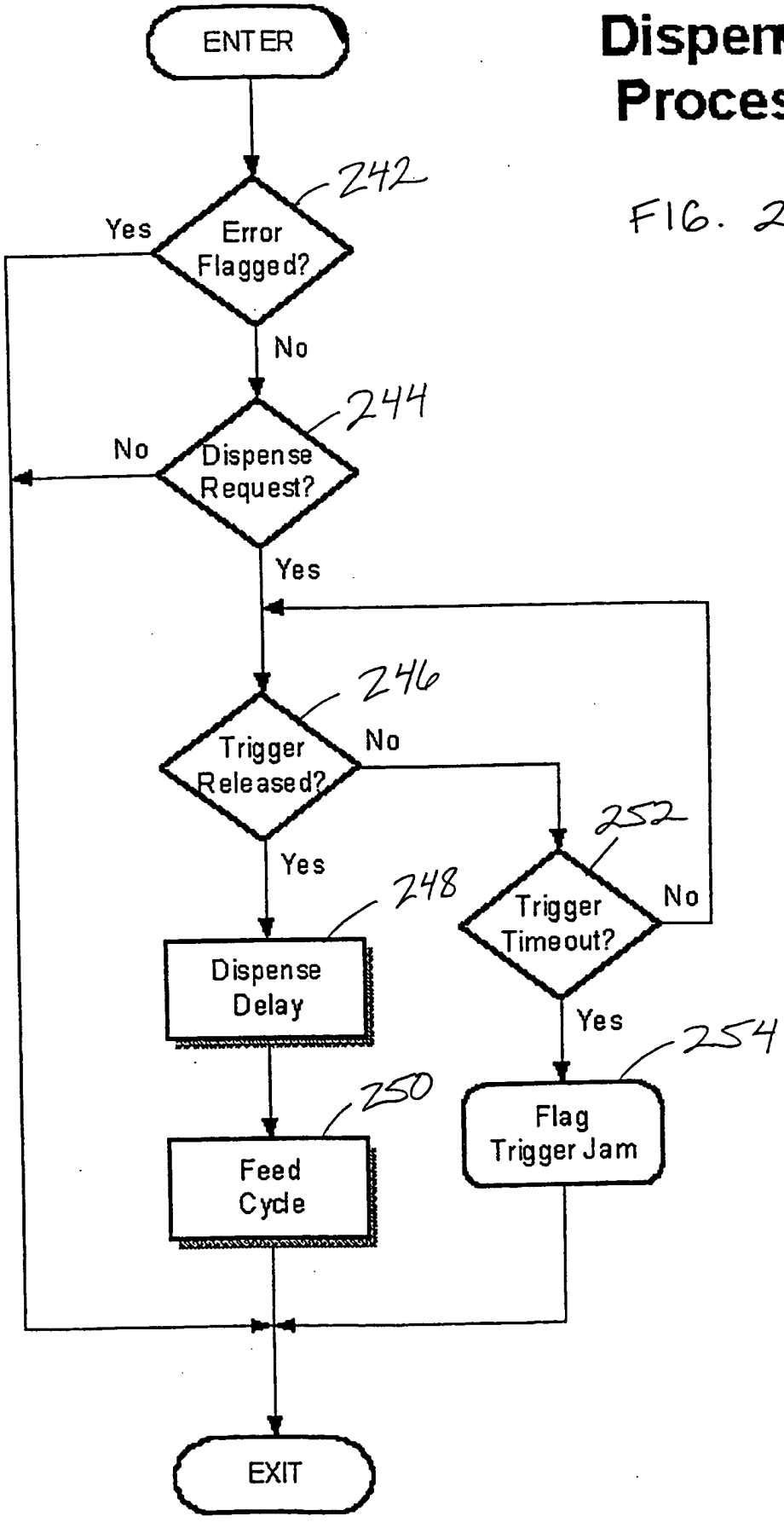
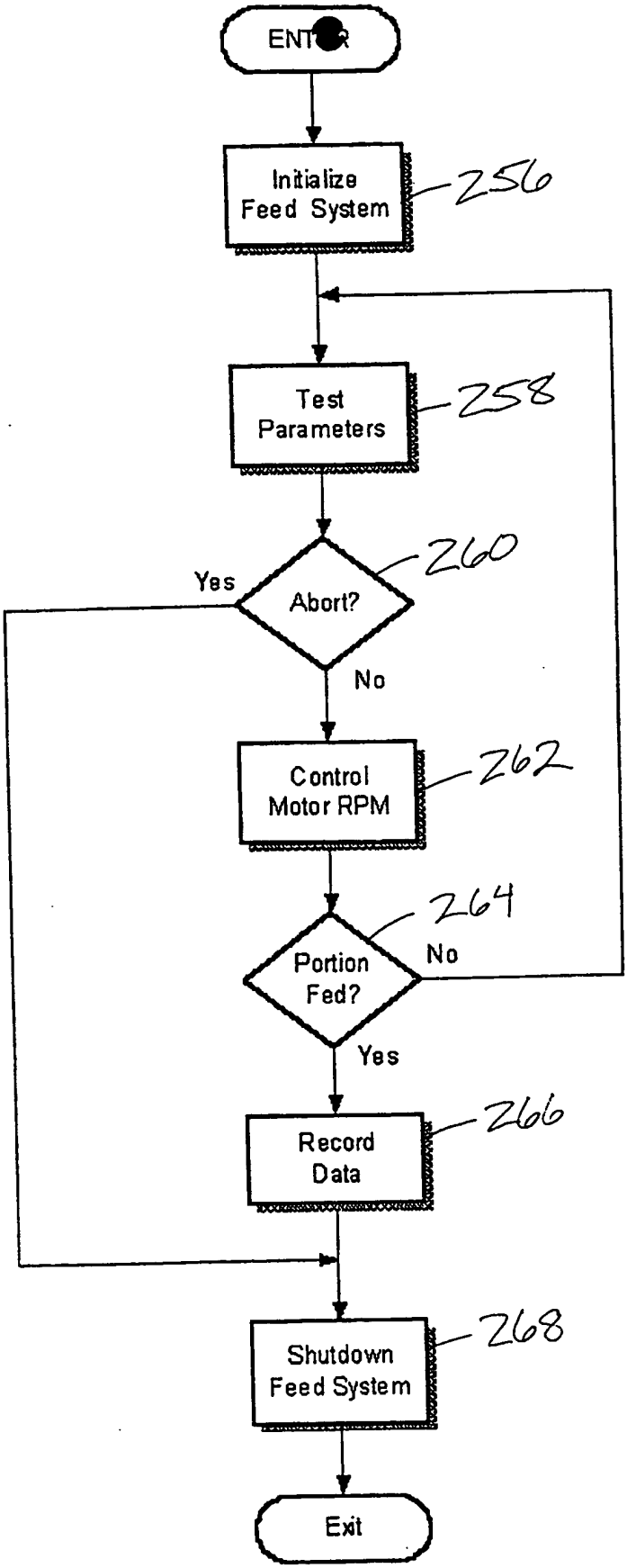


FIG. 21

Dispense Process

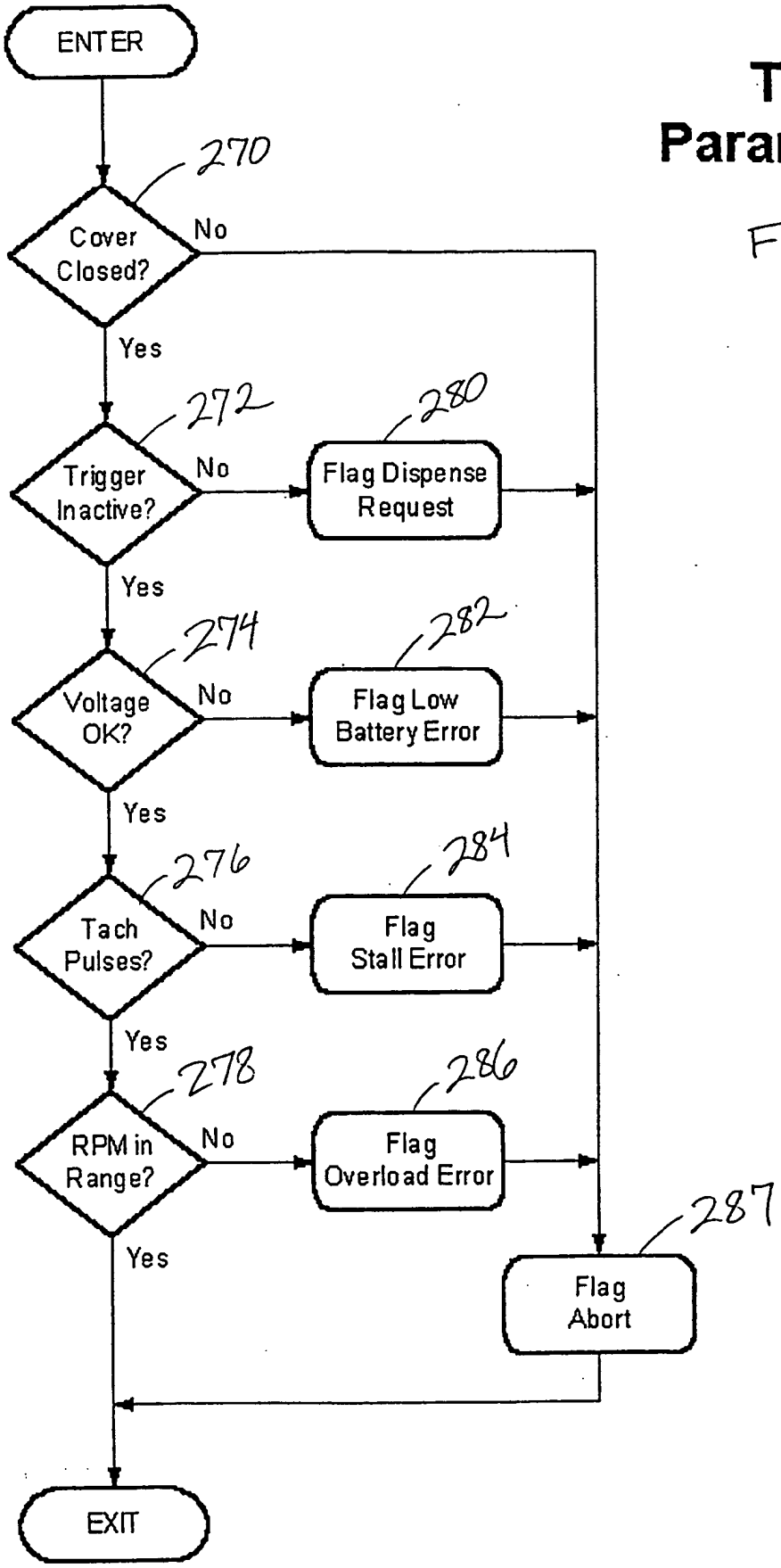
FIG. 22





Feed Cycle

FIG. 23



Test Parameters

FIG. 24

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/10761

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :B65H 26/06
US CL :242/563.2

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 242/563.2, 563, 912

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,666,099 A (HOFFMAN ET AL) 19 MAY 1987, SEE ENTIRE DOCUMENT.	1-10
Y	US 4,738,176 A (CASSIA) 19 APRIL 1988, SEE ENTIRE DOCUMENT.	1-10
Y	US 4,796,825 A (HAWKINS) 10 JANUARY 1989, SEE ENTIRE DOCUMENT.	1-10
Y	US 5,452,832 A (NIADA) 26 SEPTEMBER 1995, SEE ENTIRE DOCUMENT.	1-10
Y	US 5,691,919 A (GEMMELL ET AL) 25 NOVEMBER 1997, SEE ENTIRE DOCUMENT.	1-10
Y	US 5,772,291 A (BYRD ET AL) 30 JUNE 1998, SEE ENTIRE DOCUMENT.	1-10

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
12 JULY 2000	04 AUG 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JOHN Q. NGUYEN Telephone No. (703) 306-4177

Form PCT/ISA/210 (second sheet) (July 1998)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/10761

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y, E	US 6,069,354 A (ALFANO ET AL) 30 MAY 2000, SEE ENTIRE DOCUMENT.	1-10
Y	US 4,119,255 A (D'ANGELO) 10 OCTOBER 1978, SEE ENTIRE DOCUMENT.	1-10